

### 1) Background and motivation:

Over the past 25 years, first in industry and then in academia, I have been conducting research that addresses the issue of cleaner energy. In particular, I and my students had previously performed studies on alternative fuel engines, wind energy systems, fuel cell systems, and hybrid wind-fuel cell systems. At SPSU/KSU, I have been studying novel solar panel architectures to improve daily energy collection, and also hybrid solar-battery-fuel cell distributed generators for peak-load shaving and backup purposes. Most recently, I and my collaborators have proposed the Slim Semi-autonomous Bus Rapid Transit (SSaBRTransit) concept, which is being developed with the help of a \$175,499 grant from the Georgia Department of Transportation that aims to reduce the overall cost of a rapid transit system while increasing its operating performance and environmental-friendliness. Moreover, I am the faculty advisor for KSU's Electric Vehicle Team, which has competed well recently against teams from other (more established) engineering schools. Last, but not least, I have been teaching courses that are infused with a strong emphasis on energy efficiency; these include EE 3601 - Electric Machines (Generators and Motors), EE 3602 - Electric Power Systems, EE 3603 - Electronic Power Conversion, EE 4603 - Electric Motor Drives, and EE 6615 - Emerging Vehicle Technologies, which are being taught by me at KSU.

In light of the above, I am very much interested in what Europe has been doing recently and will be doing soon in the area of clean energy, particular in terms of solar and wind energy, and also electric cars, buses and trucks. In many ways, Europe has the edge over the U.S. in various facets of clean energy technology. Moreover, recent events have seemingly moved Europe and China further into world-leading roles on clean energy policies. Hence participating in this workshop allowed me to obtain, among other outcomes, a more close-up view and more direct exposition of European clean energy policies and how they are shaping/influencing the direction of clean energy technologies.

### 2) Comments about the workshop:

My overall impression of this workshop is that it is a very well-organized and smoothly run operation on both the KSU and EAO sides. EAO is a facility with excellent amenities, and a wonderful setting (including views of wind turbines on nearby hill ridges and solar panels on the roofs of neighboring homes) that sets the tone well for a workshop on sustainability. And then their rooms and the meals served, impress upon you that you're not in the U.S. anymore but in Europe.

The seminars/discussions that we participated in provided an introduction to Europe and a comprehensive view of various aspects of sustainability, touching on topics including sustainable development, energy, transportation, climate, water, pollution, food, recycling. Both facts and opinions were presented and discussed in a very collegial manner

The various site visits hammered home the concrete steps that Europe (Germany and Luxembourg in particular) have taken to become more sustainable, while being a nice variation of pace and setting from the seminars/discussions. Visits to a working farm (food), energy center (energy), pumped storage facility (energy), and various institutes/organizations (transportation, recycling, policy, etc) were educational and thought-provoking.

In addition, I found that the bus rides to the various non-EAO sites were among the best opportunities (along with the ample number of shared meals and social events) for me to get

to know the other faculty attendees better, particular those based on the other (Kennesaw) campus, who I otherwise would have little opportunity to interact with. And I found this development of new relationships to be most rewarding.

Among my other aims, I was hoping that this workshop would help me to ascertain the trends/changes in European *formal education* related to one or more aspects of clean energy policy and technology. While this did not occur in any meaningful way during the workshop itself, a visit that I personally arranged to Aalen University after the workshop included discussions with their Engineering faculty and a tour of their labs, which were profitable for shedding some light on this topic. While there, I was also able to establish professional contacts to potentially support a Tenured Faculty Enhancement Leave application for 2019-2020 in the area of clean energy technology.

3) How I have applied, am applying, or will apply, what I learnt at this workshop to my activities at KSU:

a. Teaching modules:

1) I have updated my undergraduate EE 3602 (Electric Power Systems) course, which I am teaching during the Fall 2018 semester, to add current European stances and initiatives on more sustainable electric power generation. As one example, but not limited to just this, where I had previously described and discussed the U.S. electricity supply's present energy source mix and the recent trend of each source, I have also described and discussed the European electricity supply's present energy source mix and the recent trend of each source.

2) Later this year, I plan to update my graduate EE 6615 (Emerging Vehicle Technologies) course, which will be offered next in Spring 2019, to add current European stances and initiatives on more sustainable transportation. As a specific example, but not limited to just this, where I currently describe and discuss the increasing number of electrified vehicles (encompassing pure electric, plug-in hybrid electric, and hybrid electric) in the U.S., I will also describe and discuss the plans that European auto manufacturers in general, and German auto manufacturers in particular, have made public to increase the number of electrified vehicles in their product lineup over the next few years while reducing the number of vehicles that run on only gasoline or diesel engines.

b. Collaborations: As part of this trip, I was able to establish contacts in Germany to support a KSU Tenured Faculty Enhancement Leave application for 2019-2020. This application will be aimed at doing publishable work related to my recent research in the area of electronic power conversion, electric motor drives, and/or electric vehicles, depending on the outcome of ongoing negotiations with my intended collaborator(s).

c. New coursework: Finally, I have been planning to develop and offer (in 2019 or 2020, depending on the outcome of the above-mentioned Leave application) an undergraduate version of EE 6615, to be titled "Electric Vehicle Power & Propulsion" that will include current European stances and initiatives on more sustainable transportation as part of the background and motivation for this course. At present, it is most likely that this developmental work will commence in Summer 2019 rather than in Spring 2019, as was originally envisioned.